

The widespread distribution of steelhead in the Central Valley, the relatively small size of populations in each tributary, and fundamental differences in life history and metapopulation dynamics compared to other listed species all suggest that steelhead monitoring will need to be broader in scope, and longer in duration than for other species.

ACTION - CMARP, in coordination with the IEP Steelhead Project Work Team, has developed a monitoring program for steelhead. Because of the anticipated broad scope and prolonged duration of this program, it should serve as the foundation upon which other monitoring components are built.

The monitoring program (IEP Steelhead Project Work Team 1999), in its base-level application, is designed to keep a pulse on the primary attributes of both existing and potentially-restorable steelhead habitat and associated steelhead populations. The plan is intended for application in tributary streams, mainstem rivers, and the delta and is suitable for addressing the identified specific knowledge gaps concerning Central Valley steelhead populations, collecting baseline information, and gauging the effects of CALFED actions.

The monitoring program has two primary components: habitat monitoring and steelhead population monitoring. The habitat component begins with habitat typing and mapping streams and rivers per the method of Snider et al. (1992). The resultant information on the distribution and abundance of mesohabitats in the stream (e.g., riffles, runs, glides, pools) provides the basis for identifying stream reaches based on stream channel attributes, and a template for allocating study effort (such as the study of juvenile steelhead rearing) per a random-stratified study design.

The steelhead population monitoring component of the plan essentially follows the basic life history of steelhead. The three main life-history compartments are spawning, rearing, and emigration. Within each of these compartments, questions are posed that provide the basis for what will be measured in the monitoring program. Each question is examined, either directly or indirectly, relative to basic habitat conditions being monitored. Thus, the plan is designed to observe population-level responses (in terms of population size and the extent to which a certain activity occurs) to variation in monitored

habitat, including variation resulting from management actions implemented under CALFED. In addition, basic biological information will be collected on individual fish to monitor potential responses in the composition and structure of the population to actions taken.

Although monitoring of steelhead spawning will occur on a stream-specific basis, rearing and emigration monitoring will occur not only at that level but also on a linked, system-wide basis. Rearing and emigration monitoring will allow tracking of juvenile steelhead through the system, to the extent possible. This activity will be coupled with marking or tagging of wild fish - in addition to the hatchery marking program - as they are sampled through the system to obtain more specific information about how steelhead use the system as they move toward the ocean, including addressing questions about rearing requirements in downstream areas.

Classifying, prioritizing, and allocating monitoring effort in tributaries can at least be partially guided by considering options for steelhead enhancement and restoration. Monitoring effort and restoration actions should be allocated across a cross-section of these enhancement options so as to maintain the biodiversity of Central Valley steelhead and their associated habitats.

More detailed monitoring of steelhead harvest in Central Valley streams is needed. Continued complete marking of hatchery releases will be essential to the success of this monitoring program.

MSCS CONSERVATION MEASURES

The following conservation measures were included in the Multi-Species Conservation Strategy (2000) to provide additional detail to ERP actions that would help achieve steelhead trout habitat or population targets.

- Coordinate protection, enhancement, and restoration of occupied and historic Central Valley steelhead ESU habitats with other federal, state, and regional programs (e.g., the San Francisco Bay Area Wetlands Ecosystem Goals Project, the Anadromous Fish Restoration Program, the U.S. Fish and Wildlife Service recovery plans, the SB 1986 program, and the

Corps' Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historic habitat use areas to avoid potential conflicts among management objectives and identify opportunities for achieving multiple management objectives.

- Implement applicable management measures identified in the restoration plan for the Anadromous Fish Restoration Program and the recovery plan for the native fishes of the Sacramento/San Joaquin Delta.
- Implement management measures as recommended by DFG that are applicable to CALFED actions and achieving CALFED objectives.
- Minimize flow fluctuations to reduce or avoid stranding of juveniles.

REFERENCES

- Barnhart, R. A. 1986. U.S. Fish and Wildlife Service Biological Report, No. 82(11.60): Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific southwest) -- steelhead. U.S. Army Corps of Engineers, TR EL-82-4, Washington.
- Bötsford, L. W., and J. G. Brittnacher. 1998. Viability of Sacramento River winter-run chinook salmon. *Conservation Biology* 12:65-79.
- Busby, P. J., T. C. Wainwright, G. J. Bryant, L. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. National Oceanic and Atmospheric Administration Technical Memorandum, NMFS-NWFSC-27: Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, Seattle.
- CMARP Steering Committee. 1999. Recommendations for the Implementation and Continued Refinement of a Comprehensive Monitoring, Assessment, and Research Program.
- Cramer, S. P., and 16 others. 1995. The status of steelhead populations in California in regards to the Endangered Species Act. S.P. Cramer & Associates, Inc., Gresham, OR.
- EA Engineering, Science, and Technology. 1992. Report of Turlock Irrigation District and Modesto Irrigation District pursuant to Article 39 of the license for the Don Pedro Project. EA Engineering, Science, and Technology, Lafayette, CA.
- Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile chinook salmon and steelhead trout in two Idaho streams. *Journal of the Fisheries Research Board of Canada* 29:91-100.
- Fausch, K. D. 1993. Experimental analysis of microhabitat selection by juvenile steelhead (*Oncorhynchus mykiss*) and coho salmon (*O. kisutch*) in a British Columbia stream. *Canadian Journal of Fisheries and Aquatic Sciences* 50:1198-1207.
- Gregory, R. S., and C. D. Levings. 1998. Turbidity reduces predation on migrating juvenile Pacific salmon. *Transactions of the American Fisheries Society* 127:275-285.
- Hallock, R. J. 1989. Report to the U.S. Fish and Wildlife Service: Upper Sacramento River steelhead (*Oncorhynchus mykiss*), 1952-1988. California Department of Fish and Game, Sacramento.
- Hallock, R. J., W. F. Van Woert, and L. Shapovalov. 1961. Fisheries Bulletin, No 114: An evaluation of stocking hatchery-reared steelhead rainbow trout (*Salmo gairdnerii gairdnerii*) in the Sacramento River system. California Department of Fish and Game, Sacramento.
- Hard, J.J., R.P. Jones, M.R. Delarm, and R.S. Waples. 1992. Pacific salmon and artificial propagation under the Endangered Species Act. U.S. Department of Commerce. NOAA Technical Memo. NMFS-NWFSC-2, 56 pp.
- Hunrichs, R. A. 1991. U.S. Geological Survey Water Supply Paper, W2375: California: Floods and Droughts. U.S. Geological Survey, Washington, D.C.
- Hutchings, J. A., and D. W. Morris. 1985. The influence of phylogeny, size and behaviour on patterns of covariation in salmonid life histories. *Oikos* 45:118-124.
- Interagency Ecological Program Steelhead Project Work Team. 1999. Monitoring, Assessment, and Research on Central Valley Steelhead: Status of Knowledge, Review of Existing Programs, and Assessment of Needs. in Comprehensive

- Monitoring, Assessment, and Research Program Plan, Tech. App. VII-11
- McEwan, D. And T.A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California Department of Fish and Game. 234 p.
- McEwan, D., J. Nelson. 1991. Steelhead restoration plan for the American River. Department of Fish and Game. 40 p.
- Menchen, R. S. 1980. Estimated freshwater sport catch of Coleman Hatchery yearling steelhead, *Salmo gairdnerii* in 1973. California Department of Fish and Game, Anadromous Fisheries Branch, Sacramento.
- Meral, G. H., and P. B. Moyle. 1998. Restoring steelhead and spring-run salmon to the American River watershed. Planning and Conservation League Foundation, Sacramento.
- Mills, T.J., D.R. McEwan, and M.R. Jennings. 1996. California salmon and steelhead: beyond the crossroads, p. 91-111. In D. Stouder, P. Bisson, and R. Naiman, (eds.), Pacific salmon and their ecosystems: status and future options. Chapman and Hall, New York.
- Mills, T.J. and F. Fisher. 1994. Central Valley anadromous sport fish annual run-size, harvest, and population estimates, 1967 through 1991. California Department of Fish and Game, Inland Fisheries Technical Report, Revised August 1994. 70 p. draft
- Multi-Species Conservation Strategy. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.
- Mount, J. F. 1995. California rivers and streams: the conflict between fluvial process and land use. University of California Press, Berkeley.
- National Marine Fisheries Service. 1996a. Factors for Decline. A supplement to the notice of determination for West Coast steelhead under the endangered species act. National Marine Fisheries Service. Protected Species Branch. Portland, Oregon. August 1996. 83 pp.
- National Marine Fisheries Service. 1996b. Steelhead Conservation Efforts. A supplement to the notice of determination for West Coast steelhead under the endangered species act. National Marine Fisheries Service. Protected Species Branch. Portland, Oregon. August 1996. 29 pp.
- National Marine Fisheries Service. 1997. Status review update for deferred and candidate ESUs of west coast steelhead. National Marine Fisheries Service, West Coast Steelhead Biological Review Team.
- National Marine Fisheries Service. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units (draft).
- National Research Council. 1996. Upstream: salmon and society in the Pacific Northwest. National Academy Press, Washington, D.C.
- Pacific Rivers Council. 1996. Healing the watershed: a guide to the restoration of watersheds and native fish in the west. 1st edition. Pacific Rivers Council, Inc. Eugene, Oregon. 220 pp.
- Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley Streams: A Plan for Action. California Department of Fish and Game. 189 p.
- Snider, B., D.B. Christopher, B.L. Jackson, and P.M. Bratovich. 1992. Habitat characterization of the lower American River. Calif. Dept. of Fish and Game and Beak Consultants. 20 pp
- Staley, J. R. 1976. Administrative Report, No. 76-2: American River steelhead, *Salmo gairdnerii gairdnerii*, management 1956-1974. California Department of Fish and Game, Anadromous Fisheries Branch, Sacramento.
- Strategic Plan for Ecosystem Restoration. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.
- U.S. Fish and Wildlife Service. 1997. Revised draft anadromous fish restoration plan: a plan to increase the natural production of anadromous fish in the Central Valley of California. U. S. Fish and Wildlife Service, May 30, 1997. 112 p.
- Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 1996. Historical and present distribution of chinook salmon in the Central Valley drainage of California. Sierra Nevada Ecosystem Project: Final report to Congress, vol. III. Centers for Water and Wildland Resources, Univ. Cal. Davis. pg. 309-361.

◆ TIDAL BRACKISH AND FRESHWATER MARSH SPECIAL-STATUS PLANT SPECIES

INTRODUCTION

Tidal brackish and freshwater marshes occur in transitional areas between open-water and upland habitats throughout the Bay and Delta and are important habitats for many plant, fish and wildlife of the Bay-Delta. Substantial loss of tidal brackish and freshwater marshes has been incurred as a result of reclamation and channel dredging and scouring, leading to the decline of many native fish, wildlife, and plant species. Special-status plants inhabiting Bay-Delta tidal marshes include Mason's lilaeopsis (*Lilaeopsis masonii*), Suisun Marsh aster (*Aster lentus*), bristly sedge (*Carex comosa*), Suisun thistle (*Cirsium hydrophyllum* var. *hydrophyllum*), soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*), rose-mallow (*Hibiscus lasiocarpus*), mad-dog skullcap, soft bird's-beak Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*), Delta mudwort (*Limosella subulata*), Delta coyote-thistle (*Eryngium racemosum*), and Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*).

SPECIES DESCRIPTIONS

DESIGNATED FOR RECOVERY

MASON'S LILAEOPSIS. Mason's lilaeopsis is a minute, turf-forming perennial plant in the carrot family (Apiaceae). It spreads by rhizomes and produces long, narrow, jointed leaves. Mason's lilaeopsis is state-listed as rare and is considered rare, threatened, or endangered by the California Native Plant Society (List 1B). Mason's lilaeopsis is semiaquatic and is usually found on saturated clay soils which are regularly inundated by waves and tidal action. Its known distribution extends from the margins of the Napa River in Napa County, east to the channels and sloughs of the Sacramento-San Joaquin Delta in Contra Costa, Solano, Sacramento, Yolo, and San Joaquin Counties. Approximately 50 occurrences of Mason's lilaeopsis were known in 1991 (DFG 1991). Populations of this species are small and fractured and few large contiguous sites exist on non-leveed sloughs or on eroding in-channel islands.

Mason's lilaeopsis has lost a large amount of its habitat through direct loss from flood control structures and rip-rap and through erosion of remnant in-channel islands. Widening of Delta channels for water transport, dredging and dumping of spoils, recreational development, and changes in water quality resulting from decreased flows in the Delta also threaten Mason's lilaeopsis. Although much of the habitat for Mason's lilaeopsis is privately owned, several State and Federal agencies have jurisdiction over the Delta waterways. One site is protected in Solano County on a DFG Ecological Reserve. DFG has been active in coordinating research on and trying to transplant the species. The trend for Mason's lilaeopsis is one of decline (DFG 1991).

SUISUN MARSH ASTER. Suisun Marsh aster is a rhizomatous perennial herb in the sunflower family (Asteraceae). Suisun Marsh aster is on CNPS's List 1B. Suisun Marsh aster has habitat requirements and a distribution similar to that of Mason's lilaeopsis, but is not known from Alameda County. Suisun Marsh aster is threatened by marsh habitat alteration and loss. Factors leading to marsh habitat alteration and loss include development, agriculture, recreation, channelization, channel maintenance activities, and marsh drainage.

SUISUN THISTLE. Suisun thistle is a perennial herb in the sunflower family (Asteraceae). It has slender, erect stems that are 3-4.5 feet tall and are well-branched above. The spiny leaves are deeply lobed. The flower heads are pale lavender-rose and the flower head bracts have a distinct green, glutinous ridge on the back. Suisun thistle is proposed for federal listing as endangered and is on CNPS's List 1B. Suisun thistle is known from only 2 locations in the Suisun Marsh in Solano County (CFR 60(112)). It occurs on the edges of salt and brackish marshes that are periodically inundated during high tides. The total number of individuals of Suisun thistle is a few thousand individuals (CFR 60(112)). One occurrence is on DFG lands and a second occurrence is on Solano County Farmland and Open Space Foundation lands.

Suisun thistle was probably more widespread in the past, but reductions in salt marsh habitat that have resulted from drainage or filling, and possibly water pollution, may have contributed to the species' decline (Niehaus 1977). Its present highly restricted distribution increases its susceptibility to catastrophic events such as disease or pest outbreak, severe drought, oil spills, or other natural or human caused disasters. Continued habitat conversion, habitat fragmentation, indirect effects from urban development, increased salinity, projects that alter natural tidal regime, mosquito abatement activities, competition with non-native plants, and inadequate regulatory mechanisms also threaten this taxon (CFR 60(112)).

SOFT BIRD'S-BEAK. Soft bird's-beak is a sparingly-branched, semi-parasitic herbaceous annual plant in the figwort family (Scrophulariaceae). Its stems are covered by soft hairs, and it bears white two-lipped flowers. Soft bird's-beak is proposed for federal listing as endangered and is state-listed as rare. Soft bird's-beak occurs along the northern shores of the San Francisco Bay, in Suisun Marsh, and in the salt marshes south of Suisun Bay. A dozen historical occurrences were known from Marin to Contra Costa Counties, where the counties border San Francisco Bay. In 1991, the species was known to be extant at only three sites: Benicia State Recreation Area, DFG land along the Napa River at Fagan Slough, and Point Pinole Regional Shoreline (California Department of Fish and Game 1992). Recently, several new populations have been discovered at salt marshes near Martinez and at Suisun Marsh (Natural Diversity Data Base 1996). Soft bird's-beak inhabits the upper reaches of salt grass-pickleweed marshes at or near the limits of tidal action. Soft bird's-beak is susceptible to factors similar to those listed above for Suisun thistle (CFR 60(112)).



VISIONS

The vision for Mason's lilaeopsis is to recover this State listed rare plant by protecting and preserving important habitat sites within the Bay-Delta.

The vision for Suisun Marsh aster is to recover this California Native Plant Society List 1B plant species.

The vision for Suisun thistle is to recover this federally listed endangered species by protecting and preserving important habitat sites within the Bay-Delta.

The vision for soft bird's beak is to recover this federally listed endangered species by protecting and preserving important habitat sites within the Bay-Delta.

DESIGNATED CONTRIBUTE TO RECOVERY

BRISTLY SEDGE. Bristly sedge is a rhizomatous perennial herb in the sedge family (Cyperaceae). Bristly sedge is considered rare, threatened, or endangered in California but more common elsewhere by CNPS (List 2). Bristly sedge occurs around lake margins in Contra Costa, Lake, Shasta, San Joaquin, and Sonoma Counties. It is also widespread outside of California, occurring in Idaho, Oregon, and Washington. Bristly sedge is threatened by marsh habitat alteration and loss.

DELTA TULE PEA. Delta tule pea is a herbaceous perennial plant in the legume family (Fabaceae). Delta tule pea is on CNPS's List 1B. Delta tule pea inhabits freshwater and brackish marshes in Alameda, Contra Costa, Fresno, Marin, Napa, Sacramento, San Benito, Santa Clara, San Joaquin, and Solano Counties. Delta tule pea is threatened by marsh habitat alteration and loss. Factors leading to marsh habitat alteration and loss include development, agriculture, recreation, channelization, channel maintenance activities, and marsh drainage.

DELTA MUDWORT. Delta mudwort is a stoloniferous perennial herb in the figwort family (Scrophulariaceae). Delta mudwort is considered rare, threatened, or endangered in California but more common elsewhere by CNPS (List 2). Delta mudwort inhabits marshes in Contra Costa, Sacramento, San Joaquin, and Solano Counties. It is also found on the Atlantic Coast. Delta mudwort is threatened by marsh habitat alteration and loss. Factors leading to marsh habitat alteration and loss are similar to those described above for Delta tule pea.

POINT REYES BIRD'S-BEAK. The Point Reyes bird's-beak is a hemiparasitic, annual herb of the figwort family that grows 10-40 centimeters tall. It

is listed as a Category 1B plant by the CNPS. The species grows in coastal saltmarshes. Point Reyes bird's-beak is distributed throughout the northern portion of the north coast and the northern portion of California's central coast. Point Reyes bird's-beak occurs or has the potential to occur in the Suisun Marsh/North San Francisco Bay Ecological Management Zone. The current range of this plant has been reduced by development. Other threats include foot traffic and trampling, competition from non-native plants, altered marsh hydrology, pollution, and cattle grazing.

DELTA COYOTE-THISTLE. Delta coyote-thistle, also known as delta button celery, is a herbaceous perennial in the carrot family. Delta coyote-thistle is listed as endangered under CESA and as a Category 1B plant by the CNPS. The historical distribution of this plant includes Calaveras, Merced, Stanislaus, and San Joaquin counties. Of the approximately 20 known occurrences, about one-third have been extirpated, including all occurrences in San Joaquin County and most of Stanislaus County. Most extant occurrences are found in Merced County along the San Joaquin River. Delta coyote-thistle occurs or has the potential to occur in the Eastside Delta, East San Joaquin, San Joaquin River and the West San Joaquin Ecological Zones. This plant grows 10-50 centimeters tall and occurs at elevations of 15-75 feet. Delta Coyote-thistle occurs on clay soils on sparsely vegetated margins of seasonally flooded floodplains and swales, freshwater marshes, and riparian areas.



VISIONS

The vision for bristly sedge is to contribute to the recovery of this California Native Plant Society List 2 plant species.

The vision for Delta tule pea is to contribute to the recovery of this California Native Plant Society List 1B plant species.

The vision for Delta mudwort is to contribute to the recovery of this California Native Plant Society List 2 plant species.

The vision for Point Reyes bird's-beak is to recover this California Native Plant Society List 1B plant species.

The vision for Delta coyote-thistle is to recover this State listed endangered species and California Native Plant Society List 1B plant species.

DESIGNATED FOR MAINTAIN

MAD-DOG SKULLCAP. Mad-dog skullcap is a rhizomatous perennial herb mint family (Lamiaceae). Mad-dog skullcap is considered rare, threatened, or endangered in California but more common elsewhere by CNPS (List 2). Mad-dog skullcap inhabits mesic meadows and marshes and in California is known from only 2 occurrences in Inyo and San Joaquin Counties (Skinner and Pavlik 1994). Mad-dog skullcap also occurs in New Mexico and Oregon. Mad-dog skullcap is threatened by marsh habitat alteration and loss.

ROSE-MALLOW. Rose-mallow is a herbaceous perennial plant in the Mallow family (Malvaceae). Rose-mallow is considered rare, threatened, or endangered in California but more common elsewhere by CNPS (List 2). Rose-mallow is relatively widespread along the lower portions of the Sacramento and San Joaquin Rivers, but most occurrences are very small. The species prefers open, freshwater marsh habitats along slow-moving watercourses, and is often found on peaty substrates in association with bulrush (*Scirpus* sp.). Rose-mallow does not tolerate shade from dense woody vegetation. Rose mallow is threatened by marsh habitat alteration and loss. Factors leading to marsh habitat alteration and loss include development, agriculture, recreation, channelization, channel maintenance activities, and marsh drainage.



VISIONS

The vision for mad-dog skullcap is to maintain populations of this California Native Plant Society List 2 plant species.

The vision for rose-mallow is to maintain populations of this California Native Plant Society List 2 plant species.

The visions for these tidal brackish and freshwater marsh guild of plant species are to provide protections for existing populations and restore

habitats to provide sites for expansion of the species. Existing populations should be protected through acquisition or cooperative efforts with landowners, beginning with the highest quality sites. A site-based evaluation of populations would be conducted to all rank sites based on criteria developed to assess habitat and population conditions. Higher ranked sites that are protected would serve as a source of propagules for restored areas.

Higher quality sites will also be evaluated for potential enhancement opportunities through habitat expansion. Moderate or low quality sites will be restored to low elevation intertidal habitats and establishment of species in this guild promoted. Restoration efforts would include protecting eroding sites, such as on in-channel islands, from further erosion.

INTEGRATION WITH OTHER RESTORATION PROGRAMS

Efforts to restore habitat for the Delta plant species will involve cooperation with programs being implemented by DFG to promote their occurrences and cooperation from agencies with responsibility or authority for maintaining or restoring tidal perennial habitat, including:

- California Department of Fish and Game,
- U.S. Fish and Wildlife Service,
- U.S. Army Corps of Engineers,
- Delta Protection Commission
- Benicia State Recreation Area,
- Point Pinole Regional Shoreline, and
- Solano County Farmland and Open Space Foundation.

Other programs that could be solicited for collaboration to benefit the Delta species include the Montezuma Wetlands Project and Tidal Wetlands Species Recovery Plan.

LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

The Delta guild of plant species is integrally linked with the restoration of tidal perennial aquatic habitat.

Stressors that could affect the Delta guild include non-native species such as water hyacinth that shades out habitat when occurring in dense patches; levees, bridges, and bank protection; dredging; water management; human disturbance; and contaminants. Tides are an important primary physical process that affects the tidal brackish and freshwater plant species guild.

OBJECTIVE, TARGETS, ACTIONS, AND MEASURES



The Strategic Objective is to achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta, Suisun Bay, and Suisun Marsh.

SPECIES TARGETS

MASON'S LILAEOPSIS: Expand suitable habitat by 100 linear miles and protect at least 90% of the currently occupied habitat including 90% of high quality habitat occurrences in the North, South, and East Delta and Napa River Ecological Management Units.

SUISUN MARSH ASTER: Expand suitable habitat by 100 linear miles and protect at least 90% of the currently occupied habitat including 90% of high quality habitat occurrences in the North, South, and East Delta and Napa River Ecological Management Units.

SUISUN THISTLE: Maintain the current distribution and existing populations of Suisun thistle, establish 10 new populations, and increase overall population size tenfold.

SOFT BIRD'S-BEAK: Maintain the current distribution and existing populations of soft bird's-beak and reestablish and maintain viable populations throughout its historic range.



The Strategic Objective is to contribute to the recovery of at-risk species in the Bay-Delta estuary and its watershed.

SPECIES TARGETS

BRISTLEY SEDGE: Research habitat requirements and use knowledge gained to develop and implement specific recovery measures.

DELTA TULE PEA: Protect at least 90% of occupied habitat, including 90% of high quality habitat, throughout the range of the species to protect geographic diversity, and expand suitable habitat by 100 linear miles.

DELTA MUDWORT: Protect at least 90% of occupied habitat, including 90% of high quality habitat, throughout the range of the species to protect geographic diversity, and expand suitable habitat by 100 linear miles.

POINT REYES BIRD'S-BEAK: Maintain, enhance and restore suitable high marsh and high marsh-upland transition habitat around San Pablo Bay.

DELTA COYOTE THISTLE: Survey all extant populations and suitable habitat and update status and ownership information. Bring at least ten of the largest extant, naturally occurring populations found during surveys into permanent protected status and bring at least 50% of all extant populations and individuals under permanent protected status. Manage protected populations for long-term viability. Increase suitable habitat by 50% over existing extent. Increase populations and individuals by 25% over present existing numbers.



The Strategic Objective is to maintain abundance and distribution.

SPECIES TARGETS

MAD-DOG SKULLCAP: An increase in or no discernable adverse effect on the size or distribution of species populations.

ROSE-MALLOW: An increase in or no discernable adverse effect on the size or distribution of species populations.

LONG-TERM OBJECTIVE: Have self-sustaining populations of Mason's lilaeopsis, Suisun Marsh aster, Suisun thistle, soft birds-beak, rose-mallow, Delta mudwort, and Delta tule pea and similar declining

endemic species located throughout their original native range in marshes associated with the Bay-Delta system.

SHORT-TERM OBJECTIVE: Protect existing populations of the species and restore habitat to provide sites for expansion of all rare native species that require tidal or brackish water marshes.

RATIONALE: The species listed here are examples of plants that are largely endemic to brackish water marshes of Suisun Bay and elsewhere in the estuary. The likelihood of extinction among these species varies from very high for Suisun thistle, known from only four occurrences, to moderate for Mason's lilaeopsis, which is widely distributed throughout the Delta. In combination, these seven species require a range of declining tidal marsh habitats in the Bay-Delta system. Although only two of the species (Suisun thistle and soft bird's beak) are formally listed as endangered, restoration of all these species to the point where they are fairly common would indicate that major marsh restoration projects in the region had succeeded.

STAGE 1 EXPECTATIONS: The status of the seven species listed here will have improved. Surveys of present ranges of the species (and other rare marsh plants), studies of their ecological requirements, and identification of key restoration sites will have been completed. Ongoing marsh restoration projects in the Bay-Delta system will have been evaluated according to their success at restoring rare native plant species and lessons learned applied to new projects.

RESTORATION ACTIONS

The following actions would contribute to improving the tidal/brackish and freshwater marsh special-status plant species populations:

- Conduct a site-based evaluation of populations and rank sites based on criteria developed to assess habitat and populations conditions.
- Acquire lands supporting existing populations or develop cooperative relationships with landowners to protect existing populations, beginning with the highest quality sites.
- Develop appropriate methods to protect and restore habitat and populations of the tidal

brackish and freshwater marsh special-status plant species.

- Manage protected areas occupied by the species to promote conditions favorable for the establishment, growth, and vigor of the species. Include management techniques such as exotic weed control and hydrologic regulation.
- Restore moderate or low quality sites to low elevation intertidal habitats and promote establishment of species in this guild. During the restoration of habitat, promote ecological functions such as sediment deposition and erosion to balance the formation and loss of intertidal habitats.

MSCS CONSERVATION MEASURES

The following conservation measures were included in the Multi-Species Conservation Strategy (2000) to provide additional detail to ERP actions that would help achieve habitat or population targets for tidal brackish and freshwater plant species.

MASON'S LILAEOPSIS AND SUISUN MARSH ASTER

- Maintain processes that support the dynamic habitat distributed throughout the species range and associated with existing source populations (species occurs on eroding margins of levees).
- To the extent practicable, design restoration of tidal habitats to create unvegetated, exposed substrate habitat at tidal margins of tidal fresh emergent wetland and riparian habitat.
- To the extent consistent with CALFED objectives, incorporate sufficient edge habitat to support the species in levee set back and channel island habitat restoration designs.
- To the extent practicable, maximize sinuosity of restored and created slough channels to increase water-land edge habitat.
- To the extent consistent with CALFED objectives, maintain and restore habitat and populations throughout the species' geographic ranges and expand habitat and populations to their historical and ecological ranges based on hydrologic, salinity and other habitat requirements of the species.

- Consistent with CALFED objectives, incorporate suitable habitat for these species in band protection designs used in CALFED actions.
- Monitor status and distribution of the species at five-year intervals and document expansion of the species into restored habitat for the duration of the Program.

SUISUN THISTLE

- Identify opportunities for establishing new populations or expanding existing populations and habitat.
- Control and reduce populations of non-native marsh species with potential effects on Suisun thistle and potential Suisun thistle habitat.
- Monitor the population size and vigor of all extant occurrences at a two-year interval for the duration of the Program.
- Modify conservation measures according to the adaptive management process as more understanding is developed of recovery needs.

SOFT BIRD'S-BEAK

- Expand potential habitat by improving tidal circulation to diked wetlands that sustain some existing exchange.
- Identify opportunities for establishing new populations or expanding existing populations and habitat.
- Establish soft bird's-beak populations to existing and restored suitable habitat.
- Control and reduce populations of non-native marsh species with potential effects on soft bird's beak and potential soft bird's-beak habitat.
- Monitor the populations size and vigor of all extant occurrences at two-year interval for the duration of the program and design and implement remediation measures if the recovery goal is not met.
- Modify conservation measures according to the adaptive management process as more understanding is developed of recovery needs.

BRISTLEY SEDGE

- Identify and implement opportunities to restore suitable wetland habitat within ERP nontidal freshwater marsh restoration actions.

DELTA TULE PEA AND DELTA MUDWORT

- Maintain process that support the dynamic habitat of Delta mudwort and Delta tule pea throughout the species range and associated with existing source populations.
- To the extent consistent with CALFED objectives, create unvegetated, exposed substrate at tidal margins of restored and created tidal fresh emergent wetland and riparian habitat.
- Maximize sinuosity of restored and created slough channels to increase water-land edge habitat.
- Monitor existing populations and their habitat at five year intervals.

POINT REYES BIRD'S-BEAK

- Identify and implement restoration of suitable habitat in high marsh and marsh/upland transition areas. Incorporate high marsh and margin suitable habitat in ERP salt marsh restoration programs.
- Maintain and restore Point Reyes bird's-beak around San Pablo Bay in conjunction with restoration of saline emergent wetlands.
- Prepare and implement a management plan to control and reduce non-native weeds near existing and new populations.

DELTA COYOTE-THISTLE

- Survey all extant populations and suitable habitat and update ecological, population, and ownership information.
- Bring at least 10 of the largest, extant, naturally occurring populations found during surveys into permanent protected status.
- Establish and protect new populations in newly created floodplain habitat along the San Joaquin River and associated sloughs in Merced and Stanislaus counties.
- Restore, enhance, and protect suitable habitat near existing populations and avoid impacts on existing populations to the greatest extent practicable during restoration activities.
- Monitor the status and distribution of all (natural and restored) populations at two-year intervals for the duration of CALFED and evaluate the need for active reintroduction into restored and

enhanced habitat when natural colonization does not occur. Evaluate appropriate habitat management measures for maintaining suitable habitat.

ROSE MALLOW

- To the extent consistent with ERP objectives, create unvegetated, exposed substrate at tidal margins of restored and created tidal fresh emergent wetland and riparian habitats.
- To the extent consistent with CALFED objectives, incorporate suitable habitat for this species into levee improvement, levee set back, and channel island habitat restoration designs.
- To the extent consistent with ERP objectives, maximize sinuosity of restored and created slough channels to increase water-land edge habitat.

REFERENCES

- Department of Fish and Game. 1991. Annual Report on the Status of California State Listed Threatened and Endangered Animals and Plants. Sacramento, CA.
- California Department of Fish and Game 1992 - CALFED Bay-Delta Program Special Status Plants and Animals Draft Affected Environment Technical Report (Appendix A. Federally Listed Plants and Animals) Sept. 23, 1996
- Multi-Species Conservation Strategy. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.
- Niehaus 1977 - CALFED Bay-Delta Program Special Status Plants and Animals Draft Affected Environment Technical Report (Appendix A. Federally Listed Plants and Animals) Sept. 23, 1996
- Strategic Plan for Ecosystem Restoration. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.
- Stone, R.D., G.L. Clifton, W.B. Davilla, J.C. Stebbins, and D.W. Taylor. 1987. Endangerment status of the grass tribe Orcuttieae and Chamaesyce hooveri (Euphorbiaceae) in the Central Valley of California.